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Pithecellobium dulce (Roxb.) Benth Guamúchil, Madras thorn

Leguminosae (Mimosoideae) Legume family

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Pithecellobium dulce (Roxb.) Benth. is a fast-growing, medium-sized tree native to the American tropics (fig. 1). It has been widely introduced elsewhere for reforestation and ornamental purposes and for the production of fuelwood, fodder, and numerous other products. Mature trees are commonly 5 to 22 m in height with a short trunk 30 to 75 cm in diameter at breast height (d.b.h.); a broad, spreading crown; and light-gray, generally smooth bark (*22*). The slender,7 drooping twigs bear bipinnately compound leaves with four oblong leaflets, and there are paired spines at the base of the leaves in most specimens (fig. 2, *23*).

HABITAT

Native Range

The native range of guamúchil extends from latitudes 3° to 28° N. and includes the Pacific slopes of Mexico and southern California through all of Central America to northern Colombia and Venezuela (fig. 3, *30*). In Mexico, it also grows naturally in the Yucatan and in an area including parts of Tamaulipas, San Luis Potosí, Queretaro, Hidalgo, Puebla, and northern Veracruz (*26*). It was introduced to the Philippines through early colonial trade and was soon after carried to India, where it was first described and given its botanical name in 1795 (*22*, *26*). The tree is planted and naturalized in many areas outside its native range, including southern Florida, Cuba, Jamaica, Puerto Rico, St. Croix, Hawaii, the Philippines, India, and East Africa (*14*, *22*, *26*, *27*, *35*).

Climate

In guamúchil's native range, the climate is dry to semiarid subtropical and tropical with mean annual rainfall ranging from 500 to 1000 mm. The species now grows in natural stands along the north coast of Puerto Rico, where annual rainfall reaches 1775 mm. It has been successfully planted in areas with a mean annual rainfall as low as 400 mm and with a maximum dry season of 4 to 5 months (*22*, *31*). The species is generally considered to be heat and drought resistant (*19*). Guamúchil reportedly grows well in semiarid regions of India characterized by mean monthly temperatures ranging from 7 to 8 °C in January to 40 to 42 °C in May and June (*31*).

Soils and Topography

Guamúchil tolerates a wide range of soil types, including clays, rocky limestone soils, nutrient-poor sands, and soils with a high, brackish water table (*11*, *22*, *30*). In India, the tree is reported to grow well on saline sites (*9*) and on severely eroded, montane wastelands (*31*).

Where it is native, guamúchil is common in dry thickets or forests on coasts, plains, and hillsides to an altitude of 1,800 m (*22*, *26*). The thorn forests of the Pacific Coastal Plain region of Mexico are characterized by poor, rocky soils on slopes adjacent to tropical savanna woodlands (*6*).

Figure 1.—*Roadside planting of guamúchil* (Pithecellobium dulce) *near Ponce, Puerto Rico.*

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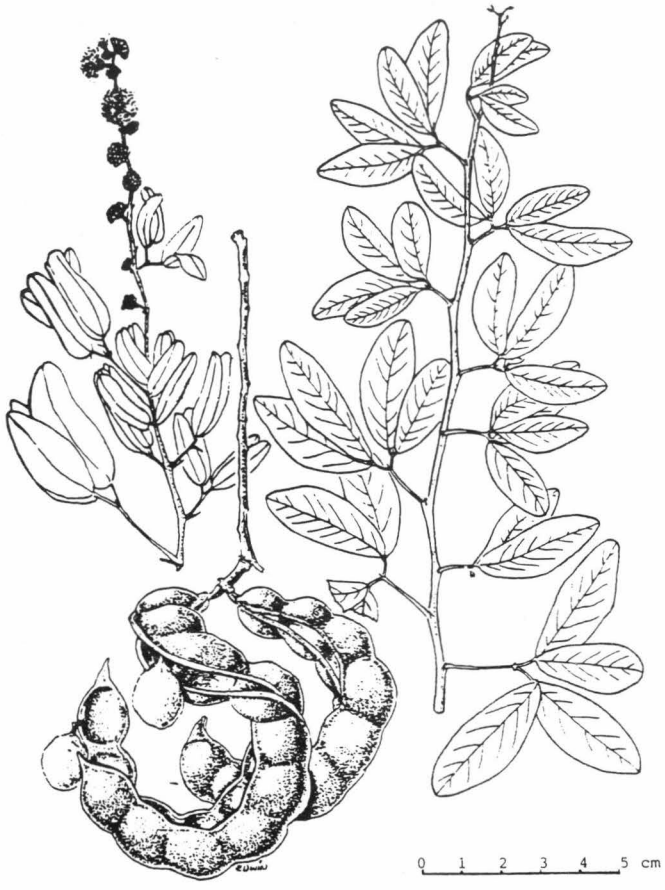

Figure 2.—*Foliage and fruit of guamúchil.* (Pithecellobium dulce) (24).

Associated Forest Cover

In the thorn forests or tropical deciduous forests of its native Pacific slope range, guamúchil commonly grows in association with *Bursera* spp.; arborescent *Ipomoea* spp.; and Leguminosae, including *Acacia* spp.; as well as *Opuntia* spp., *Lemaireocereus* spp., and other columnar cacti. It is also found growing in dry, pine-oak forests (*26*).

In the southern and western regions of Mexico, guamúchil is often associated with *Prosopis pallida* (H. & B. ex Willd.) H.B.K., the former dominant on more humid sites, the latter on drier sites (*32*). In the Mexican states of Jalisco and Colima, guamúchil grows in the dense, coastal thorn forest in association with *Acacia cymbispina* Sprague & Riley, *Achatocarpus gracilis* H. Walt., *Bursera instabilis* McV. & Rzed., *Caesalpinia coriaria* (Jacq.) Willd., *Celtis* sp., *Croton alamosanus* Rose, *Lemaireocereus* sp., *Ruprechtia fusca* Fernald, and *Ziziphus amole* (Sess. & Moc.) M.C. Johnst. (*32*). It is also found in tropical deciduous forests in the coastal regions of Chiapas (Mexico) in association with *Achatocarpus nigricans* var. *inermis* Suesseng., *Alvaradoa amorphoides* Liebm., *Bursera excelsa* var. *favionalis* MC. V. & Rzed., *Capparis flexuosa* (L.) L., *C. indica* (L.) Fawc. & Rendle, *Coccoloba caracasana* Meisn., *C. floribunda* Lindau., *Randia armata* (Swartz) DC., *Jacquinia aurantiaca* Ait., *Maba purpusii* T.S. Brandeg, *Pithecellobium recordii* (Britt. & Rose) Standl., *Prosopis pallida*, *Rauvolfia hirsuta* Jacq., *Swietenia humilis* Zucc., *Trichilia hirta* L., and *T. trifolia* L. (*32*).

In tropical deciduous forests and thorn woodlands of the Isthmus of Tehuantepec, guamúchil is commonly associated with *Acacia cornigera* (L.) Willd., *A. farnesiana* (L.) Willd., *A. pringlei* Rose, *A. cymbispina* Sprague & Riley, *Amphipterygium adstringens* (Schlecht.) Schiede, *Bauhinia albiflora* Britt. and Rose, *B. pauletia* Pers., *Caesalpinia coriaria* (Jacq.) Willd., *C. eriostachys* Benth., *Casearia nitida* Jacq., *Cordia curassavica* (Jacq.) Roem. & Schult., *Croton guatemalensis* Lotsy, *Diphysa floribunda* Peyr., *Haematoxylum brasiletto* Karst., *Jacquinia aurantiaca*, *Pereskia conzattii* Britt. & Rose, *Piptadenia flava* Benth., *Pithecellobium tortum* Mart., *Prosopis laevigata* (Willd.) M.C. Johnst., and *Randia aculeata* L. (*6*, *32*).

In seasonally flooded, tropical dry forests of Costa Rica, guamúchil is commonly associated with *Acacia costaricensis* Schenck, *Erythrina glauca* Willd., *Guazuma ulmifolia* Lam., *Parkinsonia aculeata* L., *Tabebuia pentaphylla* (L.) Hemsl., and *Trichilia trifolia* L. (*33*). In Puerto Rico, guamúchil has become naturalized in many coastal regions and commonly grows in association with *Prosopis pallida* along the fringes of mangrove forests. Guamúchil also grows at somewhat higher elevations in open woodlands with *A. farnesiana*, *P. pallida*, and *G. ulmifolia*.

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Guamúchil may first produce flowers when trees are 2 years of age (*11*). Flowering generally occurs between December and May, and fruit can be found on trees most often from February to August, depending on the locality (*23*, *26*). In Puerto Rico, fruiting has been observed throughout the year. Flowers are borne on short-stalked, whitish, racemelike or spiciform panicles 10 to 20 cm in length and 1.0 to 1.5 cm in diameter, often in terminal compound inflorescences. Each panicle is composed of 20 to 30 densely hairy flowers (*23*). Individual flowers are white with a calyx 1.5 mm long and a pubescent corolla 3.0 to 4.5 mm long (*26*).

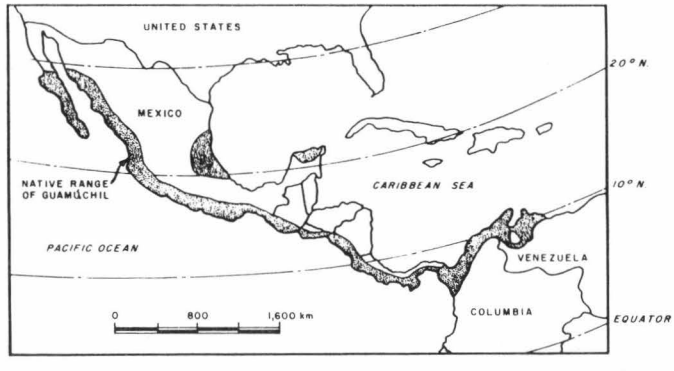

Figure 3.—*Shaded area represents approximate native American range of guamúchil* (Pithecellobium dulce).

The fruits, which ripen approximately 3 to 4 months after flowering, usually between March and August, are linear, curved, or coiled pods up to 20 cm long and 10 to 15 mm broad. The dehiscent pods are plump, constricted between the seeds, and short-pilose, with fleshy white arils surroundings the seeds (*26*).

Seed Production and Dissemination.—Pods generally contain 5 to 12 shiny, black, beanlike seeds, each about 1 cm long (*22, 26*). The number of seeds per kilogram ranges from 6,000 to 26,000 (*40*).

Seedling Development.—Natural regeneration of guamúchil is extremely good on most sites where stands are found, and the seedlings have become a weed problem in some areas to which it has been introduced (*14, 22, 30*). Seeds do not require scarification or other pretreatment for germination (*10*). Germination occurs 1 to 2 days after sowing (*30*). Germination for fresh seeds ranges from 20 to 70 percent (*40*). Seeds remain viable in storage for approximately 6 months (*10, 30*).

Propagules can be produced from seeds or cuttings (*10, 22*). In Puerto Rico, nursery-grown seedlings were ready for outplanting when mean height reached 40 cm, approximately 3 months after sowing.[1] Average height growth during the first 6 months was 1.4 m in field trials conducted in Thailand (*16*).

Vegetative Reproduction—Guamúchil coppices vigorously when cut, an attribute that has popularized its cultivation in hedgerows and fuelwood plantations (*10, 30*). Epicormic branching is very common, and trees with multiple stems often result from basal sprouting. Root damage gives rise to suckers that are very thorny (*30*). Tissue culture plantlets have been produced from mesophyll protoplasts (*34*).

Sapling and Pole Stage to Maturity

Growth and Yield.—On favorable sites, guamúchil reportedly grows to a height of 10 m in 5 to 6 years (*30*). In adaptability trials conducted at a subtropical dry site (as defined in *18*) in Guatemala (within its native range), mean heights of 0.8, 0.8 and 1.7 m were recorded at 6, 13, and 21 months of age (*8*).

In rain-fed plantation trials conducted at a semiarid, montane wasteland site in central India, early survival and growth rates were closely related to slope position, with consistently better growth on the lower slopes. At 5 years of age, the rate of survival ranged from 25 to 100 percent, the mean tree height from 0.9 to 3.0 m, and the mean d.b.h. from 1.8 to 4.4 cm (*31*).

Rooting Habit.—As a seedling, guamúchil first produces a taproot and then lateral roots. As trees mature, they develop an extensive, shallow lateral root system (*10*). Guamúchil is widely reported to form a symbiotic association with *Rhizobium* bacteria, enabling the tree to fix nitrogen under appropriate conditions (*2, 4*).

[1] Data on file at the Institute of Tropical Forestry, Southern Forest Experiment Station, Rio Piedras, PR.

Reaction to Competition.—Although described as shade tolerant (*4*), guamúchil is more accurately classed as moderately intolerant and is susceptible to competition from weeds during the early establishment phase (*31*). Once established, however, the tree is extremely competitive, often excluding other tree species and shading out forage plants in pastures (*30*).

Damaging Agents.—In Hawaii, the fruits and seeds of guamúchil are reportedly susceptible to attack by the larvae of *Subpandesma anysa* Gn. (*38*). In Puerto Rico, the hemipteran *Umbonia crassicornis* Amyot & Serville has been reported as a pest of guamúchil (*25*). The bark-boring larvae of *Indarbela* sp. have been reported to attack the tree in India (*39*). The lepidopteran *Polydesma umbricola* is considered a serious pest of the species of the island of Reunión in the Indian Ocean (*13*).

In India, five leaf-spot pathogens have been reported to infect guamúchil: *Cercospora mimosae* Agarwal & Sharma, *Colletotrichum dematium* (Pers. ex Fr.), *C. pithecellobii* Roldan, *Phyllosticta ingae-dulcis* Died., and *P. pithecellobii* Shreemali (*28*). Heartrot caused by *Phellinus* sp. has been reported in India (*20*).

The tree is susceptible to branch breakage, trunk snap, and uprooting in high winds (*10, 22*). In Puerto Rico, this species was one of the most heavily damaged by Hurricane Hugo in September 1989; furthermore, poor recovery of roadside trees following hurricane damage has been reported in Florida (*23*). The species is generally considered to be susceptible to frost damage, although there may be considerable genetic variation in cold tolerance. In India, seedlings produced from seeds imported from Sonora (Mexico) were found to be tolerant of light frosts, unlike those produced from local seeds (*10, 37*)

SPECIAL USES

Guamúchil is extensively planted in Latin America and in parts of Asia and Africa for wasteland reclamation, as a roadside ornamental, in shelterbelt and fuelwood plantations, and in hedgerows for production of protein-rich livestock fodder (*14, 17, 21, 22*). On sandy coastal sites in southern India, the tree is sometimes interplanted with *Casuarina equisetifolia* Forst. & Forst. as a safeguard against fungal pathogens in casuarina (*10, 37*).

The white to yellowish sapwood and yellowish to reddish-brown heartwood (*14*) are brittle, fine-textured, and moderately hard, with a specific gravity of 0.64 g/cm^3 (*10, 22*). Though not easily worked, the wood is durable and is used for paneling, boxes, crates, wagon wheels, general construction, posts, and fuel (*2*). The wood has an unpleasant odor when freshly cut. As a fuel, for which it is widely used, it produces a smoky fire and has a caloric content of 5.2 to 5.6 kcal/g (*10, 22*).

In Mexico and India, the fruits are commonly sold in country markets for the sweet, acidic, edible arils, which are consumed raw or roasted or are used in a beverage resembling lemonade (*1, 2, 22, 24, 26*). The seeds are eaten in Southeast Asia (*12*). The species is also known as a good forage plant for honeybees (*11*).

Guamúchil is widely used in Mexico and in its introduced Asian range as a source of tannins, dyes, numerous medici-

nal products, and timber (*15*, *36*). Among the Huastec Indians of northern Veracruz and San Luis Postosí (Mexico), products from the tree are used to treat toothaches, gum sores, and cankers (*1*). The bark is sometimes used medicinally as an antipyretic (*5*), although it has irritating properties that can cause eye infections and swelling of the eyelids (*12*). Tannin concentrations of 18 and 10 percent have been reported for the bark and leaves, respectively (*24*). The transparent, reddish-brown gum exuded from the trunk makes a good water-soluble mucilage (*2*, *24*). A greenish oil extracted from the seeds, containing high levels of myristic and palmitic acids, can be used for human consumption or processed for use in soapmaking (*3*, *22*). The press cake residue in rich in protein (30 percent) and may be used as stockfeed (*30*). An extract from guamúchil twigs has been reported to be an effective check against the tobacco mosaic virus in India (*29*).

GENETICS

The genus *Pithecellobium* contains approximately 100 to 200 species of shrubs and small trees distributed mainly in tropical America and Asia (*2*). *Pithecellobium unguis-cati* (L.) Benth. is a related shrub or small tree with a native range that extends from southern Florida to northern South America (*23*). Botanical synonyms of *P. dulce* include *Pithecolobium dulce* Benth. (*14*), *Mimosa dulcis* Roxb., and *Inga dulcis* Willd. (*26*, *37*). The generic name is derived from the Greek for "ape's earring," referring to the coiled pods of some species; the Latin species name, meaning "sweet," describes the edible seed pulp (*22*). The species has a diploid (2n) chromosome number of 26 (*7*).

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